

**To:** Tom Pagano

**From:** Thomas Hearty

**CC:** H. Aumann, S. Broberg, S. Friedman, S. Gaiser, T. Hearty, S. Lee, S. Licata, E. Manning, E. Olsen, K. Overoye, D. Ting, M. Weiler

**Subject:** AIRS Level 1B Infrared Quality Assessment Parameters

**Summary:** This memo describes changes to the Level 1B QA Requirements that have been implemented in version 2.7.x of the PGE.

## 1 Introduction

This document provides a brief description of the AIRS Level 1B algorithms have been altered as a result of experience with in-flight AIRS data. The latest version of the L1B requirements document should be consulted for a precise explanation of these algorithms. The affected algorithms and L1B Quality Assessment parameters are listed in Table 1.

Table 1: Changed Parameters

Algorithm	PGE Version	Affected L1B parameters
AutomaticQAFlag	2.6.5.5	<b>AutomaticQAFlag</b>
DC Restore	2.2.3.0	<b>DCR_scan</b>
offset	2.6.5.5	<b>radiances</b>
Pop Detection	2.6.8.2, 2.6.10.3, 2.6.16.3	<b>SpaceViewDelta, radiances</b>
Noise Estimation	2.6.16.3	<b>NeN, input_space_signals, input_bb_signals</b>
Moon-in-View	2.7.10.3	<b>CalFlag, CalScanSummary</b>
gain	2.7.10.3	<b>input_bb_signals, CalFlag</b>

## 2 AutomaticQAFlag

The **AutomaticQAFlag** has been altered so that it no longer depends on the **CalGranSummary**.

## 3 DC Restore and Space View Offset

The new DC Restore and space view offset algorithms have already been described in ADFM #573. Briefly, these new algorithms correctly account for a delay between when the DC Restore actually occurs and when it is reported in the Level 1A telemetry. Also, the effect of DC Restores has been

accounted for in the calculation of the space view offset and DC Restores are no longer mistakenly flagged as pops.

## 4 Pop Detection

After launch the calibration team realized that the pop detection algorithm used by the PGE flagged numerous events that are not actual pops. These “events” have come to be known as “cold scene noise.” These are intermittent periods in which detectors appear to be very noisy while viewing space but are less noisy while viewing a source. Examining a long time series of data shows that only a small number of channels with  $ABstate < 3$  exhibit this type of behavior. Nevertheless, a new algorithm was developed which defines a pop as a discontinuity in the detector offset that is sustained for  $\geq 2$  sets of calibration footprints (i.e.,  $> 1$  scan line).

Although the new “pop” detection algorithm was altered so that it would only flag events that exhibit classic pop behavior (i.e., a sharp discontinuity in the detector offset), some “cold scene noise” events still cause the “pop” bit to be set in the calibration flags in the scan line before a DC Restore because of the lack of a suitable warm target to use in the algorithm. However the occurrences of “cold scene noise” being flagged as pops has been severely curtailed.

Also, the threshold for flagging pops has been increased so that the offset must change by  $7 \times$  the standard deviation of **SpaceViewDelta** to be flagged as a pop. Since this threshold is very large, it leaves many significant pops undetected. Thus the threshold will be reduced by the next major release of the PGE.

## 5 NeN algorithm

A new NeN algorithm has been implemented which includes the noise of of the detectors when viewing space *and* the noise when viewing the On Board Calibration source. This new algorithm was accompanied by the creation of 2 new L1B QA limited engineering structures: **input\_space\_signals** and **input\_bb\_signals**. The new limited engineering structures are similar to **input\_space\_counts** and **input\_bb\_counts** but they provide statistics on the signals rather than the counts.

The NeN is computed once per granule for each channel for an assumed scene temperature of 250 K using the following equation:

$$NeN = gain \sqrt{N_{250}/N_{T_{bb}}} (Noise_{bb}^2 - Noise_{sv}^2) + Noise_{sv}^2$$

where,

**gain** = **gain\_stats.mean**

$T_{obc}$  = **input\_bb\_temp.mean**

$Noise_{sv}$  = **mean(input\_space\_signals.dev)**

$Noise_{bb}$  = **input\_bb\_signals.dev**

$N_{250} / N_{T_{obs}} =$  Ratio of the Planck Function evaluated at 250 K and at the temperature of the “On-Board Calibrator.”

When the NeN for a given channel exceeds the noise limits, the “noise out of bounds” bit is set in the **CalChanSummary** (and **CalGranSummary** if any channel with ABstate < 3 exceeds the threshold). Currently, the “noise out of bounds” bit is set if the NeN is different by more than 50% of an expected value. The expected value is the median NeN taken over a long period (> 100 granules) after “noise out of bounds” conditions have been removed.

## 6 Moon-in-View algorithm

The Moon has come into the space view June 13-15, November 14, December 11-15, January 10-14, February 10-?. Since the Moon has a noticeable affect on the offset calculation the space views in which the Moon is present are not used to calculate the offset, the NeN, and they are omitted from the statistics when calculating the limited engineering structures **input\_space\_signals** and **input\_bb\_signals**. A bit is also set in the **CalFlag** and **CalScanSummary** to indicate the scan lines in which the Moon was in one of the 8 space views normally used in the offset calculation.

## 7 gain bit

The “gain” bit in the calibration flags is now set when the signal is < 2% of the dynamic range while viewing the On Board Calibration source.

## 8 Remaining Changes to be made

There are several remaining changes that will be made to the Level 1B QA parameters and algorithms before the release of version 3.0 of the PGE.

1. The Pop detection threshold will be reduced. Version 2.7.x of the PGE still has large pops that are not flagged because they are below the current pop detection threshold.
2. Some channels with ABstate < 3 occasionally exhibit “cold scene noise.” They are currently flagged by the “noise out of bounds” bit in the **CalChanSummary** and **CalGranSummary**. The calibration team will account for these channels either by adjust their ABstate so that they no longer exhibit “cold scene noise,” make their ABstate > 2, or alter the definition of **ExcludedChans** so they will no longer be reported in the **CalGranSummary**.
3. The “moon-in-view” bit in the **CalFlag** and **CalChanSummary** of PGE version 2.7.x may occasionally flag scan lines that have DC Restores as having the moon in view. This has already been fixed in PGE version 2.8.x.